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(54) Method and assembly for a self centering tucker on a folding roll

Verfahren und Vorrichtung für ein selbstzentrierendes Falzschwert eines Falzzylinders

Procédé et dispositif pour une lame de pliage auto-centrant d'un cylindre à pliage

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Description

[0001] This invention generally relates to a folding machine for folding sheets of material, and more specifically, to a folding machine that includes a self-centering tucker assembly configured to interact with an adjacent gripper assembly to create an interfolded stack of sheets.

[0002] Folding of sheets of material (e.g., paper, napkins, paper towels, tissue, etc.) is frequently performed using a pair of folding rolls that have interacting mechanical gripper and tucker assemblies. The gripper and tucker assemblies are uniformly spaced around a circumference of each respective folding roll to interact with one another so as to interfold the sheets of material. The tucker assemblies on one roll interact with the gripper assemblies of the adjacent roll, and vice versa, to alternately grip and tuck successive sheets of material fed assemblies carry and release the folded sheets of material to create a zigzagged interfolded stack of sheets.

[0003] Typically, each tucker assembly includes a rigid structure, referred to as a tucker, that protrudes from a slot or cavity in the outer surface of its the folding roll, and each gripper assembly is contained within a recess or slot in the folding roll. The tucker terminates in a point that extends outwardly of the outer surface of the folding roll, and is rigidly fixed in the slot or cavity in the folding roll to interface with a gripper assembly on the adjacent folding roll. As both the first and second folding rolls rotate, the tuckers that protrude from the outer surface of the first folding roll engage the gripper assemblies of the adjacent second folding roll, and vice versa. The sheets are fed between the first and second folding rolls, such that engagement of the tuckers and grippers of the folding rolls functions to fold the sheets during advancement of the sheets between the folding rolls. However, the protruding tucker typically rotates at a surface speed greater than the recessed gripper assembly in the adjacent roll, which can cause a snapped release of the tucker that interrupts and bounces the gripper assembly. The bounce can cause the gripper assembly to release the sheet of material and interrupt the output of the interfolding machine. Also, in the event the timing between the grippers and tuckers becomes disrupted, the interfolding machine can jam and the tucker can cause damage to the gripper and to the surface of the folding roll.

[0004] There is thus a need for a tucker assembly for a folding roll of an interfolder that can accommodate the difference in surface speed between the points of the tuckers and the grippers. There is also a need for a tucker that is capable of accommodating variations in grippers. There is also a need for a tucker that is capable of accommodating variations in the location of engagement of the tucker with the gripper, to prevent jamming that can occur when the timing between the rolls is disrupted.

[0005] US-A-3640522 discloses a sheet folding apparatus having a folding roll with a tucker apparatus associated therewith in the form of a bracket provided at each end of the roll and journal mounted on the shaft of the

roll, each bracket including an open slot in which is received a tucking blade that is anchored in place by means of a pin, a spring being provided in a bore in the bracket which biases the tucking blade outwardly.

[0006] According to a first aspect of the present invention there is provided a tucker roll assembly configured to interact with a gripper assembly of an adjacent rotating roll for folding a sheet of material, the tucker roll assembly comprising: a rotating roll having a slot formed therein, in which is mounted a tucker assembly; the tucker assembly comprising: a tucker element disposed in the slot; a spring disposed in the slot behind the tucker element, the spring biasing the tucker element in an outward direction; a retainer arrangement configured to retain the tucker element in the slot against the bias of the spring; and a pivot arrangement interposed between the roller and the tucker element for pivotably mounting the tucker element to the roller for movement about a pivot axis; wherein the tucker element is retractable into the slot against the bias of the spring.

[0007] The present invention further provided a folding machine for folding for folding a sheet of material, comprising: a first tucker roll assembly according to the invention; and a second tucker roll assembly according to any of the preceding claims; the rotating roll of each tucker roll assembly including a plurality of tucker assemblies distributed about its periphery alternately spaced with a plurality of gripper assemblies, wherein each gripper assembly of one of the first and second tucker roll assemblies is positioned to interact with one of the tucker assemblies of the other of the first and second tucker roll assemblies for folding a sheet of material therebetween.

[0008] The present invention still further provides a method of interacting a tucker assembly of a folding roll with a gripper assembly mounted on an adjacent folding roll with a sheet of material therebetween, the method comprising the acts of: providing a tucker roll assembly according to the invention, orienting a tucker assembly of the tucker roll assembly adjacent to a gripper assembly of the adjacent folding roll; rotating the tucker roll assembly and adjacent roll such that the tucker element of the tucker roll assembly interfaces with the gripper assembly of the adjacent roll; forcing the tucker element to engage the sheet of material against the gripper assembly; and pivoting the tucker element about a pivot arrangement of the tucker assembly.

[0009] Preferably the tucker assembly also includes a cap that is configured to retain the tucker element in the cavity or slot against the bias of the spring. A laterally extending pin is disposed in the transverse passage of the tucker element. The pin extends through a roller, which is configured to pivot or roll the tucker element along a mating roll surface defined by the cavity or slot. The tucker element is configured to retract against the bias of the spring, and the biasing force of the spring combined with the pivotable mounting of the tucker element functions to self-center the tucker element within the slot.

[0010] In a preferred embodiment, the cap includes an arcuate outer face, and an inner surface of the cap defines a slot configured to receive the laterally extending pin, which is biased by the spring against the cap. The tucker element includes a base portion opposite the pointed outer end defined by the tucker element, and the base portion includes a recess within which the outer end of the spring is received. At least a portion of the laterally extending pin extends in a generally axially outwardly from the base portion of the tucker element and is received between a slot in the base portion of the tucker element and the slot portion in the cap. The tucker element further includes a recess within which the roller is received. The tucker element can further include a second transverse passage to receive a second laterally extending pin, in general alignment with the first transverse passage and first laterally extending passage within which the first pin is engaged. At least an outer end portion of the second pin is engaged with an adjacent tucker element. The tucker element may also include a second recess to receive a second roller mounted on the second pin.

[0011] In order that the invention may be well understood, there will now be described some embodiments thereof, given by way of example, reference being made to the accompanying drawings, in which:

FIG. 1 is an isometric view of an interfolding machine employing a folding roll incorporating a tucker assembly in accordance with the present invention;

FIG. 2 is a schematic side elevation view of the interfolding machine as shown in FIG. 1;

FIG. 3 is a detailed cross-sectional view of first and second folding rolls incorporated in the interfolding machine as shown in FIGS. 1 and 2, illustrating a first embodiment of a tucker assembly in accordance with the present invention;

FIG. 4 is an exploded isometric view of the tucker assembly as shown in FIG. 3;

FIG. 5 is a partial cross-sectional view of the tucker assembly along line 5-5 of FIG. 3;

FIG. 6 is a detailed side elevation view of a tucker element incorporated in the tucker assembly shown in FIG. 4;

FIG. 7 is a detailed bottom elevation of the tucker element shown in FIG. 4;

FIG. 8 is a detailed end elevation view of the tucker element shown in FIG. 4;

FIG. 9 is a an enlarged partial cross-sectional view of the tucker assembly of a first folding roll and the

gripper assembly of an adjacent folding roll of the interfolding machine shown in FIG. 2, showing the tucker assembly approaching the gripper assembly during advancement of a sheet of material therebetween;

FIG. 10 is a view similar to FIG. 9, showing the tucker assembly tucking the sheet of material into the gripper assembly;

FIG. 11 is a view similar to FIGS. 9 and 10, showing the gripper assembly gripping the sheet of material;

FIG. 12 is a view similar to FIGS. 9-11, showing pivoting movement of the tucker element of the tucker assembly to release the sheet of material;

FIG. 13 is an enlarged detailed cross-sectional view of the tucker element of the tucker assembly as shown in FIG. 12;

FIG. 14 is a view similar to FIGS 9-12, showing the tucker assembly disengaged from the gripper assembly;

FIG. 15 is an exploded isometric view of a second embodiment of a tucker assembly incorporated in the folding rolls of an interfolding machine as shown in FIGS. 1 and 2;

FIG. 16 is an enlarged partial section view similar to FIG. 5, showing the second embodiment of the tucker assembly as illustrated in FIG. 15;

FIG. 17 is a detailed side elevation view of a tucker element incorporated in the tucker assembly as shown in FIGS. 15 and 16;

FIG. 18 is a detailed bottom plan view of the tucker element shown in FIG. 17;

FIG. 19 is a detailed end elevation view of the tucker element shown in FIG. 17;

FIG. 20 is a detailed cross-sectional view similar to FIGS. 9-12, showing the tucker assembly of FIG. 15 interacting with the gripper assembly of the adjacent folding roll, in a position in which the tucker assembly releases the sheet of material;

FIG. 21 is a detailed cross-sectional view similar to FIG. 20, showing the tucker assembly of FIG. 15 in a position in which the tucker assembly is disengaged from the gripper assembly; and

FIG. 22 is an enlarged detailed cross-sectional view of the tucker assembly shown in FIG. 20.

1. Folding Machine

[0012] Referring to FIGS. 1 and 2, an interfolding machine 25 is operable to convert a web of material 30 into a stack of interfolded sheets of material shown at 32. Interfolding machine 25 includes folding rolls incorporating the tucker assembly of the present invention, and generally includes a first pull roll 35 and a second pull roll 40 that receive the web of material 30 along a path (illustrated by an arrow 42 in FIG. 2) from a supply roll (not shown) into the interfolding machine 20. The first and second pull rolls 35 and 40 define a nip through which the web of material 30 passes, and function to unwind the web of material 30 and feed the web of material 30 in a path (illustrated by an arrow 44 in FIG. 2) toward a nip defined between second pull roll 40 and a bed roll 45. The web of material 30 is then advanced by bed roll 45 toward a knife roll 50. In a manner as is known, the knife roll 50 cuts the web of material 30 into sheets, each of which has a predetermined length, and the bed roll 45 carries the sheets of material along a path (illustrated by arrow 52 in FIG. 2) toward and through a nip defined between bed roll 45 and a retard roll 55, which rotates at a slower speed of rotation than the bed roll 45. The retard roll 55 cooperates with a nip roller assembly 60 (FIG. 2) to form an overlap between the consecutive sheets of material. The retard roll 55 carries the overlapped sheets of material along a path (illustrated by arrow 68 in FIG. 2) to a lap roll 65.

[0013] The lap roll 65 works in combination with a count roll 75 to eliminate the overlap between adjacent sheets of material at a predetermined sheet count, so as to create a separation in the stack 32 of interfolded sheets discharged from the interfolding machine 25. The lap roll 65 carries the overlapped sheets of sheet 30 along a path (illustrated by arrow 78 in FIG. 2) toward a nip defined between a first assist roll 80 and an adjacent second assist roll 85. The first and second assist rolls 80 and 85 feed the sheets of the material to a nip defined between a first folding roll 90 and a second folding roll 95.

[0014] Referring to FIG. 2, the first and second folding rolls 90 and 95 generally rotate in opposite directions (illustrated by arrows 96 and 98, respectively, in FIG. 2) to receive the overlapped sheets of material 30 therebetween. The periphery of the first folding roll 90 generally includes a series of the tucker assemblies 20 in accordance with the invention, and a series of gripper assemblies 100 uniformly and alternately spaced to interact with a series of tucker assemblies 20 and gripper assemblies 100 of the adjacent second folding roll 95. The series of alternately spaced tucker assemblies 20 and gripper assemblies 100 of the first and second folding rolls 90 and 95 interact to grip, carry, and release the sheets of material in a desired manner so as to form the desired interfolded relationship in the sheets of material and to form stack 32 of interfolded sheets. The folding rolls 90 and 95 may be driven by a drive system 110 having a drive belt assembly 115 (FIG. 1).

[0015] The stack 32 of interfolded sheets is discharged from between the first and second folding rolls 90 and 95 in a generally vertically-aligned fashion. The stack 32 of interfolded sheets may be supplied to a discharge and transfer system (not shown), which guides and conveys the stack 32 from the generally vertically-aligned orientation at the discharge of the interfolding machine 25 to a generally horizontally-aligned movement. One embodiment of a suitable discharge and transfer system is described in U.S. Patent No. 6,712,746 entitled "Discharge and Transfer System for Interfolded Sheets," filed May 5, 2000, the disclosure of which is hereby incorporated herein by reference in its entirety.

2. Tucker Assembly

[0016] As illustrated in FIG. 2, each of the gripper assemblies 20 is generally located at a distance from the next adjacent tucker assembly 100 along a circumference of each of the first and second folding rolls 90 and 95. The spacing between the gripper assemblies 100 and the tucker assemblies 20 determines the longitudinal dimension or length between the folds in the sheets of sheet 30 as measured in a direction of travel (illustrated by arrows 96 and 98) of the first and second folding rolls 90 and 95.

[0017] FIGS. 3 illustrates a detailed cross-sectional view of folding rolls 90 and 95, showing one of the series of tucker assemblies 20 in accordance with the present invention, and which is mounted to folding roll 95, interacting with one of the series of gripper assemblies 100 of folding roll 90. It is understood that the other alternating series of gripper assemblies 100 and tucker assemblies 20 of both the first and second folding rolls 90 and 95 (as schematically illustrated in FIG. 2) are constructed similarly and interact in a similar manner. As illustrated in FIG. 3, the tucker assembly 20 generally extends in a radial outward direction from the outer circumference of the folding roll 95 to engage the gripper assembly 100 that is generally positioned in a recessed location on the folding roll 90. As the sheet of material 30 moves between the first and second folding rolls 90 and 95, the tucker assembly 20 is configured to tuck the sheet 30 between a blade 116 and an anvil 118 of the gripper assembly 100, when the gripper assembly 100 is in an open position. The blade 116 of the gripper assembly 100 subsequently rotates in a timed manner to grip the tucked sheet 30 against anvil 118 as the tucker assembly 20 is moved out of engagement with the sheet 30. In the closed position, the gripper assembly 100 carries and then releases the sheet 30 so as to create the folds in the sheets 30 that are formed in interfolded stack 32.

[0018] FIGS. 3-5 show one embodiment of the tucker assembly 20 in accordance with the present invention. In the illustrated embodiment, tucker assembly 20 has a sectioned tucker element 125, a first and a second tucker cap 130 and 132, respectively, a first and a second roller 134 and 136, respectively, a first and a second pin 140

and 142, respectively, and a spring 155 disposed in a cavity or slot 160 in the folding roll 95. It is understood that others in the series of tucker assemblies 20 of the first and second folding rolls 90 and 95 are constructed in similar manner.

[0019] The spring 155 generally biases the tucker element 125 in a radially outward direction (illustrated by arrow 16) with respect to the outer periphery or circumference 165 of the folding roll 95.

[0020] FIGS. 6-8 show the tucker element 125 of FIGS. 3-5 in detail. The tucker element 125 includes a pointed end 180, a midsection 185, and a base portion 190. The pointed end 180 is configured to engage the gripper assembly 100 of the adjacent folding roll 90 (FIG. 3). The base portion 190 of the tucker element 125 includes a recess or opening 195 to receive the outer end of the spring 155. First and second transverse pin openings or passages 200a and 200b, respectively, extend along an axial length of the tucker element 125 and are configured to receive the pins 140 and 142, respectively. A pair of inner recesses 215a and 215b extend outwardly from the inner surface of the base portion 190 of the tucker element 125, and are configured to receive the rollers 134 and 136, respectively. The number of recesses 215a and 215b and respective rollers 134 and 136 can vary. An outer recess 220 extends inwardly from the pointed end 180. Another pair of openings 225a and 225b pass through the midsection 185. The openings 225a and 225b receive fasteners (not shown) to hold the pins 140 and 142 in position on the tucker element 125.

[0021] Referring back to FIGS. 4 and 5, the tucker caps 130 and 132 are generally disposed between adjacent tucker elements 125 (See FIG. 3) in a manner so as to restrain the pins 140 and 142 and the tucker element 125 against the bias of the spring 155. As illustrated in FIG. 4, the tucker caps 130 and 132 generally include respective outer faces 230 and 232 and respective inner faces 235 and 236. The outer faces 230 and 232 are generally arcuate-shaped, and match an arcuate shape of an inner surface 240 defined by an outer wall section 245 of the folding roll 95 (See FIG. 3). The inner faces 235 and 236 are generally configured to interface with the base portion 190 of the tucker element 125 and with an inner surface 250 of the folding roll 95 (See FIG. 3). The inner faces 235 and 236 further include slot portions 255 and 256, respectively, which retain at least a portion of the pins 140 and 142, respectively, against base portion 190 of the tucker element 125. Fasteners 258 and 260 in combination with the caps 130 and 132, respectively, mount the tucker element 125 to the folding roll 95 against the bias of the spring 155.

[0022] Still referring to FIGS. 4 and 5, the pins 140 and 142 are engaged within the openings or passages 200a and 200b, respectively, in the tucker element 125. The pins 140 and 142 extend into aligned axial passages in rollers 134, 136, respectively, and define inner portions that are received within aligned passages in rollers 134, 136, respectively, to support the tucker 125 on the rollers

134 and 136, respectively. The pins 140 and 142 extend axially outwardly from the tucker element 125, and are received between the slot portions 255 and 256 of the caps 130 and 132 and outwardly facing troughs formed in the base portion 190 of the tucker element 125. The pins 140 and 142 and mounted rollers 134 and 136, respectively, provide rotational location and guidance for inward and outward movement of the tucker element 125 along facing walls or surfaces 265 defining the cavity or slot 160 (FIG. 3).

[0023] Folding roll 95 also defines a central axial passage AP which is supplied with pressurized air from a suitable pressurized air source, and which communicates with radial passages RP formed in folding roll 95 that supply pressurized air to cavity or slot 160 inwardly of tucker element 120 and caps 130, 132. This feature functions to expel air under pressure around the components of tucker assembly 20.

[0024] FIGS. 9-14 generally illustrate the sequence of operation of the tucker assembly 20. In FIG. 9, the tucker assembly 20 is generally held in a radially aligned position in the slot 160 by the pins 140 and 142 in combination with the caps 130 and 132 (FIGS. 4 and 5) by application of an outward biasing force applied by the spring 155. As roll 95 rotates in a clockwise direction from the position of FIG. 9 toward the position of FIG. 10, pointed end 180 of tucker element 125 contacts sheet 30 so as to create a fold or crease in sheet 30.

[0025] Tucker element 125 then interacts with the gripper assembly 100 of the adjacent roller 90 as illustrated in FIG. 10, so as to position the fold or crease in sheet 30 against the anvil of the gripper assembly 100 while the blade 116 of gripper assembly 100 is maintained in the open position. During such movement of tucker assembly 20, the spring 155 forces the tucker element 125 outwardly, and maintains tucker element 125 in a radially aligned position. Blade 116 of gripper assembly 100 is then moved to the closed position as shown in FIG. 11, so that blade 116 engages the sheet 30 within the recess 220 defined by tucker element 125, to clamp the fold in sheet 30 against the anvil 118. Continued rotation of folding rolls 90 and 95, as shown in FIG. 12, results in pivoting movement of tucker element 125 about the pins 140 and 142 (FIGS. 4 and 5) while engaged by the gripper assembly 100, so that tucker element 125 is positioned at an angle relative to the radial axis of cavity or slot 160. As the folding rolls 90 and 95 rotate, the tucker element 125 is free to move against the anvil 118 as dictated by the spring-loaded blade 116 of the gripper assembly 100. FIGS. 12 and 13 illustrate that, as the adjacent folding rolls 90 and 95 continue to rotate, the tucker element 125 pivots (illustrated by arrow 278) and retracts (illustrated by arrow 280) upon disengagement with gripper assembly 100. As the tucker element 125 pivots and retracts in this manner, the blade 116 of the gripper assembly 100 engages against the sheet 30 and the anvil 118, limiting bounce as the gripper assembly 100 carries the sheet 30. Upon continued rotation of folding rolls 90 and 95, as

shown in FIG. 14, the bias of the spring 155 and the interaction of the base portion 190 and the pins 140 and 142 against the caps 130 and 132 functions in combination to re-center the tucker element 125 in a generally radially aligned position in the slot 160.

[0026] In the event timing of the rolls 90 and 95 is off or the tucker encounters an obstruction such that the tucker element 125 comes into contact with an outer surface 285 of the adjacent roll 90 or with the anvil of gripper assembly 100, the tucker element 125 is operable to retract against the bias of the spring 155 in a radially inward direction (illustrated by arrow 280 in FIG. 13) along the slot 160. Upon retracting in the slot 160, the pins 140 and 142 are moved inwardly out of contact with the cap slot portions 255, 256. The rollers 134 and 136 roll inwardly along the surfaces 265 of slot 160, against the outward biasing force of spring 155, until the pointed end 180 of tucker element 125 is moved out of contact with the outer surface 285 or the anvil of gripper assembly 100. Rollers 134, 136 function to maintain base 190 of tucker element 125 and pins 140 and 142 in a centered position in the slot 160. Thereafter, spring 155 functions to move tucker element 125 outwardly to seat pins 140 and 142 in engagement with cap slot portions 255, 256, respectively. As explained previously, spring 155 then operates to return tucker element 125 to a radially aligned position within cavity or slot 160. This feature enables tucker assembly to accommodate slight misalignment between tucker assembly 20 and gripper assembly 100, and reduces the potential costly and undesirable jams that may otherwise occur during operation of the interfolding machine 25.

[0027] FIGS. 15 and 16 show another embodiment of a tucker assembly in accordance with the present invention. In this embodiment, the tucker assembly is shown at 300, and is mounted on adjacent folding rolls 305 and 310 that have a similar construction and operation as folding rolls 90 and 95 as shown and described previously, including alternately spaced tucker assemblies 300 and gripper assemblies 312 that are constructed similarly to gripper assemblies 100 described above.

[0028] Tucker assembly 300 is generally mounted in a slot 314 (FIGS. 20-22) in the folding roll 310. It is understood that the tucker assemblies 300 of the adjacent folding roll 305 are constructed in a similar manner. Tucker assembly 300 generally includes a tucker element 315 that cooperates with gripper assemblies 312 in a similar manner as tucker element 125 as gripper assemblies 100, described previously, to form a crease or fold in a sheet of material, shown at 450. Tucker assembly 399 further includes a first tucker cap 320 and a second tucker cap 322, a first pin 325 and a second pin 326, a first slot spring 330 and a second slot spring 332, a bumper 335, a first cartridge 340 and a second cartridge 342, and a pivot spring 345. The first cartridge 340 and the first pivot spring 330 are positioned to interface with the tucker cap 320, and the second cartridge 342 and the second pivot spring 332 are positioned to interface with tucker cap 322. The tucker element 315, the first and second pins

325 and 326, and the first and second cartridges 340 and 342 are installed in the slot 314 and retained against the bias of the first and second slot springs 330 and 332 by the tucker caps 320 and 322.

[0029] In the illustrated embodiment, tucker element 315 includes a pointed end 355, a midsection 360, and a base portion 365. The pointed end 355 of the tucker element 315 is configured to interface with the gripper assembly 312. Tucker element 315 includes a first recess 370 that extends inwardly from pointed end 355. A first opening or passage 375a and a second opening or passage 375b extend axially inwardly from the opposite ends of tucker 310, and receive inner portions of the pins 325 and 326, respectively. The outer end portions of pins 325, 326 extend outwardly of the ends of base portion 365. The tucker element 315 further includes a recess 380 in one of the faces 385 of the midsection 360 to receive the pivot spring 345, and another recess 390 in an opposite face 395 of the midsection 360 to receive the bumper 335. The location of the pivot spring 345 and bumper 335 and their respective recesses 380 and 390 can vary. The bias of the pivot spring 345 against the bumper 335 is operable to radially align the tucker element 315 in the center of the slot 314. The bumper 335 and the pivot spring 330 also act to minimize bounce in the tucker element 315.

[0030] The tucker caps 320 and 322 function to retain the tucker element 315 in the slot 314. Tucker caps 320 and 322 engage the outer ends of base portion 365, and include inner faces 395 and 396 and an outer faces 400 and 402, respectively. The inner faces 395 and 396 are configured to interface with the ends of base portion 365 of the tucker element 315 and an inner surface 405 of the roll 310. The outer faces 400 and 402 of the cap 320 are configured with an arcuate shape that matches an arcuate outer surface 410 of the roll 310. The caps 320 and 322 are secured to the roll 310 with one or more fasteners 420. The type and number of fasteners 420 can vary.

[0031] The pins 325 and 326 are forced against the respective caps 320 and 322 by the slot springs 330 and 332 and cartridges 340 and 342, respectively. The outer end portions of pins 325 and 326 protrude in an axial outward direction from the tucker element 315 and engage respective slot portions 424 and 426 defined by the caps 320 and 322, respectively. With this arrangement, the tucker element 315 pivots about a pivot axis defined by the pins 325 and 326. The outer end portions of pins 325 and 326 occupy approximately half the full length of slot portions 424 and 426 defined by respective caps 320 and 322, and a pin of an adjacent tucker element takes up the remaining portion of the length of slot portions 424 and 426, respectively, to pivotably mount the adjacent tucker element in the same manner. The length and size of the pins 325 and 326 can vary.

[0032] The cartridges 340 and 342 are centrally located within the slot 314. In the illustrated embodiment, the cartridges 340 and 342 each are generally cylindrical

structures having respective top surfaces 428 and 429 that define respective slots 432 and 433 to receive the pins 325 and 326, respectively. The cartridges 340 and 342 and respective slot springs 330 and 332 bias the tucker element 315 in a radial outward direction with respect to a circumference 434 of the folding roll 310. The caps 320 and 322 retain the tucker element 315 in the slot 314 against the bias of the cartridges 340 and 342 and respective slot springs 330 and 332.

[0033] The tucker element 315 further includes a pair of openings 435a and 435b that extend through the mid-section 360 and above the base portion 365. The openings 435a and 435b receive fasteners (not shown) to hold the pins 326 and 326 in position on the tucker element 315.

[0034] In operation, as the folding roll 310 rotates with an adjacent folding roll 305, the tucker element 315 interfaces with the gripper assembly 312 of the adjacent roll 305. As the tucker element 315 approaches a blade 440 and anvil 442 of the gripper assembly 312, the pointed end 355 of tucker element 315 engages a sheet 450, and moves the sheet 450 into contact with the anvil 442 of the adjacent gripper assembly 312. The contact of the tucker element 315 against the anvil 442 forces the tucker element 315 to pivot slightly forward against the bumper 335. As the folding roll 310 continues to rotate, the tucker element 315 moves in the opposite direction against the force of pivot spring 345. The blade 440 of the adjacent gripper assembly 312 is moved against the anvil 442 to grip the sheet 450. As the folding roll 310 continues to rotate, the tucker element 315 retracts is retracted within slot 314 against the biasing force of springs 330 and 332, which facilitates disengagement of tucker element 314 from anvil 442 and sheet 450. The blade 440 clamps the sheet 450 against the anvil 442, and the pivoting and retracting movement of tucker element 315 functions to eliminate bounce that may otherwise occur in the folding process. The pivot spring 345 in combination with the bumper 335 then return the tucker element 315 to a centered position in the slot 314, and springs 330 and 332 return tucker element 315 to its fully extended position.

[0035] In the event the tucker element 315 contacts the outer surface of the adjacent folding roll 305 or anvil 442, tucker element 315 retracts within slot 314 against the outward bias of springs 330 and 332. Tucker element 315 and attached pins 325 and 326 retract in a radial inward direction within the slot 314. As the tucker element 315 and attached pins 325 and 326 retract inwardly, the pins 325 and 326 are moved out of engagement with the caps 320 and 322, and move inwardly against the bias of slot springs 330 and 332 along with cartridges 340 and 342, respectively. The retraction of the tucker element 315 along the slot 314 prevents the tucker element 315 from damaging the adjacent roll 305 and its associated components, and also prevents jams which may otherwise occur, in the event the of a disruption in the timing of the rolls and or deviations due to manufacturing or installation tolerances. Following retraction of the tucker

element 315, the bias of the cartridges 340 and 342 and associated slot springs 330 and 332 along with the pivot spring 345 and bumper 335 act to return tucker element 315 to the extended position, and to self center the tucker element 315 in the slot 314.

[0036] It should be understood that the present invention contemplates any type of arrangement that provides pivoting movement of the tucker element relative to the folding roll, and is not limited to a pin-type pivot arrangement. For example, pivoting movement of the tucker element within the slot may be accomplished without a pivot pin by means of the base of the tucker engaging the slot edges, with the tapered area of the base accommodating pivoting movement of the tucker element. It is also to be understood that the present invention contemplates that the tucker element is at a predetermined orientation relative to the folding roll when the tucker element is in the extended position.

[0037] While the predetermined orientation may be radially aligned, it is also understood that the predetermined orientation may also be angled or biased either forwardly or rearwardly within the slot.

[0038] A wide variety of machines or systems could be constructed in accordance with the invention defined by the claims. Hence, although the exemplary embodiments of a tucker assembly 20, 300 in accordance with the invention has been generally described with reference to an interfolding machine 25 for folding sheets 30 into an interfolded stack 32, the application of the tucker assembly 20, 300 is not so limited. The tucker assembly of the invention could be employed to fold any type of sheet or web material such as 30, for a wide variety of uses to machines and is not limiting on the invention.

Claims

1. A tucker roll assembly configured to interact with a gripper assembly of an adjacent rotating roll (95) for folding a sheet of material, the tucker roll assembly comprising:

a rotating roll (90) having a slot (160) formed therein, in which is mounted a tucker assembly (20);
the tucker assembly (20) comprising:

a tucker element (125) disposed in the slot (160);
a spring (155) disposed in the slot (160) behind the tucker element (125), the spring (155) biasing the tucker element (125) in an outward direction;
a retainer arrangement (130,132) configured to retain the tucker element (125) in the slot (160) against the bias of the spring (155); the tucker element (125) being retractable into the slot (160) against the bias

- of the spring (155) **characterised in that** a pivot arrangement (134,136,140,142) is interposed between the roller (90) and the tucker element (125) for pivotably mounting the tucker element (125) to the roller for movement about a pivot axis.
2. A tucker roll assembly as recited in claim 1, wherein the retainer arrangement comprises a cap (130,132) that engages a facing surface defined by the rotating roll (90)
 3. A tucker roll assembly as recited in claim 1 or claim 2, wherein the pivot arrangement includes a pin (140,142) that extends outwardly from the tucker element (125), wherein the pin (140,142) is biased by the spring (155) against the retainer arrangement (130,132).
 4. A tucker roll assembly as recited in claim 3, wherein the retainer arrangement comprises a cap (130,132) that includes a slot portion (255,256) to receive the pin (140,142).
 5. A tucker roll assembly as recited in any of the preceding claims, wherein the tucker element (125) includes a base portion (190) opposite a pointed end (180), and wherein the base portion (190) includes a recess (195) to receive the spring (155).
 6. A tucker roll assembly as recited in claim 5, wherein the pivot arrangement includes a pin (140,142) that extends outwardly from the tucker element (125), and wherein at least a portion of the pin (140,142) is received between a slot in the base portion (190) of the tucker element and a slot portion (255,256) in the cap defined by the retainer arrangement.
 7. A tucker roll assembly as recited in any of the preceding claims, further comprising a roller (134,136) engaged within the slot (160), wherein the roller (134,136) guides movement of the tucker element (125) within the slot (160) and wherein the tucker element (125) is pivotably mounted to the roller (134,136).
 8. A tucker roll assembly as recited in claim 7, wherein the pivot arrangement includes a pair of outwardly extending pins (140,142) that extend outwardly in opposite directions from the tucker element (125), and wherein the pins (140,142) are received within passages (200a, 200b) defined by the tucker element (125), and wherein the tucker element (125) includes first and second recesses (215a, 215b) within which first and second rollers (134,136) are located, and wherein each pin (140,142) is engaged with one of the rollers (134,136) to provide pivoting movement of the tucker element (125) relative to the rollers (134,136).
 9. A tucker roll assembly as recited in claim 1, wherein the pivot arrangement includes one or more pins (140,142) engaged with the tucker element (125), and wherein each of the pins (140,142) includes an outer portion that extends in a generally axial-outward direction from the tucker element (125).
 10. A tucker roll assembly according to claim 1, wherein the tucker element (126) includes a base portion (190) opposite a pointed end (180) and a midsection (185) therebetween, and wherein the midsection (185) includes a recess (225a) to receive the spring (155).
 11. A folding machine for folding for folding a sheet of material, comprising:
 - a first tucker roll assembly according to any of the preceding claims; and a second tucker roll assembly according to any of the preceding claims;
 - the rotating roll (90,95) of each tucker roll assembly including a plurality of tucker assemblies (20) distributed about its periphery alternately spaced with a plurality of gripper assemblies (100), wherein each gripper assembly (100) of one of the first and second tucker roll assemblies is positioned to interact with one of the tucker assemblies (20) of the other of the first and second tucker roll assemblies for folding a sheet of material therebetween.
 12. A folding machine as recited in claim 11, wherein the pivot arrangement includes a pair of aligned pivot pins that extend outwardly in opposite directions from the tucker element.
 13. A folding machine as recited in claim 12, wherein a first portion of a first one of the pins is received in a first passage defined by the tucker element, and wherein a second portion of the first pin is engaged within a passage of an adjacent tucker element.
 14. A method of interacting a tucker assembly of a folding roll with a gripper assembly mounted on an adjacent folding roll with a sheet of material therebetween, the method comprising the acts of:
 - providing a tucker roll assembly according to any of claims 1 to 10,
 - orienting a tucker assembly (20) of the tucker roll assembly adjacent to a gripper assembly (100) of the adjacent folding roll (95);
 - rotating the tucker roll assembly and adjacent roll such that the tucker element (20) of the tucker roll assembly interfaces with the gripper as-

sembly (100) of the adjacent roll (95).
 forcing the tucker element (125) to engage the
 sheet of material against the gripper assembly;
 and
 pivoting the tucker element (125) about a pivot
 arrangement of the tucker assembly (20).

15. The method as recited in claim 14, the method further including the step of:

retracting the tucker element in the slot against
 the radially outward bias of the tucker element.

16. A method as recited in claim 14 or claim 15, the method further including the step of

centering the tucker element in the slot about
 the pivot arrangement.

17. The method as recited in any of claims 14 to 16, further comprising the step of:

moving the tucker element within the slot on a
 roller against a surface that defines the slot in a
 radially inward or the radially outward direction
 in the slot, and wherein the step of pivoting the
 tucker element is carried out by pivoting the tuck-
 er element on the roller.

Patentansprüche

1. Faltwalzenbaugruppe, die so konfiguriert ist, dass sie mit einer Greiferbaugruppe einer daneben liegenden, rotierenden Walze (95) zusammenwirkt und eine Materialbahn faltet, wobei die Faltwalzenbaugruppe Folgendes umfasst:

eine rotierende Walze (90) mit einem darin ausgebildeten Schlitz (160), in dem eine Faltbaugruppe (20) angebracht ist, wobei die Faltbaugruppe (20) Folgendes umfasst:

ein Faltelement (125), das in dem Schlitz (160) angeordnet ist,

eine Feder (155), die in dem Schlitz (160) hinter dem Faltelement (125) angeordnet ist, wobei die Feder (155) das Faltelement (125) nach außen hin vorspannt,

eine Haltevorrichtung (130, 132), die so konfiguriert ist, dass sie das Faltelement (125) in dem Schlitz (160) gegen die Vorspannung der Feder (155) hält, wobei das Faltelement (125) gegen die Vorspannung der Feder (155) in den Schlitz (160) eingefahren werden kann, **dadurch gekennzeichnet, dass**

eine Schwenkvorrichtung (134, 136, 140, 142) zwischen der Walze (90) und dem Faltelement

(125) angeordnet ist, mit der das Faltelement (125) schwenkbar an der Walze angebracht wird und sich um eine Schwenkachse herum bewegen kann.

2. Faltwalzenbaugruppe nach Anspruch 1, bei der die Haltevorrichtung eine Kappe (130, 132) umfasst, die in eine Auflagefläche greift, die von der rotierenden Walze (90) definiert wird.

3. Faltwalzenbaugruppe nach Anspruch 1 oder Anspruch 2, bei der die Schwenkvorrichtung einen Zapfen (140, 142) aufweist, der von dem Faltelement (125) aus nach außen hin verläuft, wobei der Zapfen (140, 142) von der Feder (155) gegen die Haltevorrichtung (130, 132) vorgespannt wird.

4. Faltwalzenbaugruppe nach Anspruch 3, bei der die Haltevorrichtung eine Kappe (130, 132) umfasst, die einen Schlitzteil (255, 256) aufweist, der den Zapfen (140, 142) aufnehmen kann.

5. Faltwalzenbaugruppe nach einem der vorhergehenden Ansprüche, bei der das Faltelement (125) einen Fußteil (190) aufweist, der einem spitz zulaufenden Ende (180) gegenüberliegt, und der Fußteil (190) eine Aussparung (195) aufweist, die die Feder (155) aufnehmen kann.

6. Faltwalzenbaugruppe nach Anspruch 5, bei der die Schwenkvorrichtung einen Zapfen (140, 142) aufweist, der von dem Faltelement (125) aus nach außen hin verläuft, und zumindest ein Teil des Zapfens (140, 142) zwischen einem Schlitz in dem Fußteil (190) des Faltelements und einem Schlitzteil (255, 256) in der Kappe, die von der Haltevorrichtung definiert wird, aufgenommen wird.

7. Faltwalzenbaugruppe nach einem der vorhergehenden Ansprüche, die des Weiteren eine Walze (134, 136) umfasst, die in den Schlitz (160) greift, wobei die Walze (134, 136) die Bewegung des Faltelements (125) in dem Schlitz (160) führt und das Faltelement (125) schwenkbar an der Walze (134, 136) angebracht ist.

8. Faltwalzenbaugruppe nach Anspruch 7, bei der die Schwenkvorrichtung ein Paar nach außen hin verlaufende Zapfen (140, 142) aufweist, die von dem Faltelement (125) aus in entgegengesetzter Richtung nach außen hin verlaufen, und die Zapfen (140, 142) in von dem Faltelement (125) definierten Durchgängen (200a, 200b) aufgenommen werden und das Faltelement (125) eine erste und eine zweite Aussparung (215a, 215b) aufweist, in denen sich die erste und die zweite Walze (134, 136) befinden, und jeder Zapfen (140, 142) in eine der Walzen (134, 136) greift und für eine Schwenkbewegung des Fal-

telements (125) in Bezug zu den Walzen (134, 136) sorgt.

9. Faltwalzenbaugruppe nach Anspruch 1, bei der die Schwenkvorrichtung einen oder mehrere Zapfen (140, 142) umfasst, die in das Faltelement (125) eingreifen, und jeder Zapfen (140, 142) einen äußeren Teil aufweist, der von dem Faltelement (125) aus in axialer Richtung allgemein nach außen hin verläuft. 5
10. Faltwalzenbaugruppe nach Anspruch 1, bei der das Faltelement (126) einen Fußteil (190), der einem spitz zulaufenden Ende (180) gegenüberliegt, sowie einen Mittelteil (185) dazwischen und der Mittelteil (185) eine Aussparung (225a) aufweist, die die Feder (155) aufnehmen kann. 10
11. Faltmaschine für das Falten einer Materialbahn, die Folgendes umfasst : 15
 - eine erste Faltwalzenbaugruppe nach einem der vorhergehenden Ansprüche und
 - eine zweite Faltwalzenbaugruppe nach einem der vorhergehenden Ansprüche,
 - wobei die rotierende Walze (90, 95) jeder Faltwalzenbaugruppe mehrere Faltbaugruppen (20) aufweist, die um ihren Umfang herum mit mehreren Greiferbaugruppen (100) abwechselnd in einem Abstand angeordnet verteilt sind, wobei jede Greiferbaugruppe (100) der ersten oder der zweiten Faltwalzenbaugruppe so positioniert ist, dass sie mit einer Faltbaugruppe (20) der jeweils anderen, d. h. der zweiten oder der ersten Faltwalzenbaugruppe zusammenwirkt und eine Materialbahn dazwischen faltet. 20 25 30 35
12. Faltmaschine nach Anspruch 11, bei der die Schwenkvorrichtung ein Paar ausgerichteter Gelenkzapfen aufweist, die von dem Faltelement aus in entgegengesetzter Richtung nach außen hin verlaufen. 40
13. Faltmaschine nach Anspruch 12, bei der ein erster Teil eines ersten Zapfens in einem von dem Faltelement definierten ersten Durchgang aufgenommen wird und sich ein zweiter Teil des ersten Zapfens in einem Durchgang eines daneben liegenden Faltelements befindet. 45
14. Verfahren für das Zusammenwirken einer Faltbaugruppe einer Faltwalze mit einer Greiferbaugruppe, die an einer daneben liegenden Faltwalze angebracht ist, wobei sich eine Materialbahn dazwischen befindet, das folgende Schritte umfasst: 50
 - Bereitstellen einer Faltwalzenbaugruppe nach einem der Ansprüche 1 bis 10,
 - Ausrichten einer Faltbaugruppe (20) der Falt-

walzenbaugruppe neben einer Greiferbaugruppe (100) der daneben liegenden Faltwalze (95), Drehen der Faltwalzenbaugruppe und der daneben liegenden Walze, so dass das Faltelement (20) der Faltwalzenbaugruppe mit der Greiferbaugruppe (100) der daneben liegenden Walze (95) gekoppelt ist, Drücken des Faltelements (125) gegen die Greiferbaugruppe, so dass es in die Materialbahn greift, und Schwenken des Faltelements (125) um eine Schwenkvorrichtung der Faltbaugruppe (20).

15. Verfahren nach Anspruch 14, das des Weiteren den Schritt aufweist, dass das Faltelement seiner radial nach außen gerichteten Vorspannung entgegen in den Schlitz eingefahren wird.
16. Verfahren nach Anspruch 14 oder Anspruch 15, das des Weiteren den Schritt aufweist, dass das Faltelement in dem Schlitz um die Schwenkvorrichtung herum zentriert wird.
17. Verfahren nach einem der Ansprüche 14 bis 16, das des Weiteren den Schritt umfasst, dass das Faltelement in dem Schlitz an einer Walze gegen eine Fläche, die den Schlitz definiert, radial nach innen oder radial nach außen bewegt wird, und bei dem der Schritt, in dem das Faltelement geschwenkt wird, **dadurch** ausgeführt wird, dass das Faltelement an der Walze geschwenkt wird.

Revendications

1. Ensemble de rouleau de pliage configuré pour interagir avec un ensemble de pince d'un rouleau de rotation adjacent (95) pour le pliage d'une feuille de matériau, l'ensemble de rouleau de pliage comprenant :
 - un rouleau de rotation (90) ayant une fente (160) formée en son sein, dans lequel est monté un ensemble de pliage (20) ;
 - l'ensemble de pliage (20) comprenant :
 - un élément de pliage (125) disposé dans la fente (160) ;
 - un ressort (155) disposé dans la fente (160) derrière l'élément de pliage (125), le ressort (155) inclinant l'élément de pliage (125) dans une direction vers l'extérieur ;
 - un agencement de retenue (130, 132) configuré pour retenir l'élément de pliage (125) dans la fente (160) contre l'inclinaison du ressort (155) ; l'élément de pliage (125) étant rétractable dans la fente (160) contre l'inclinaison du ressort (155), **caractérisé en ce qu'**un agencement de pivot (134, 136, 140, 142) est interposé entre le

- rouleau (90) et l'élément de pliage (125) pour monter à pivotement l'élément de pliage (125) au rouleau pour le mouvement autour d'un axe de pivot.
2. Ensemble de rouleau de pliage selon la revendication 1, dans lequel l'agencement de retenue comprend un capuchon (130, 132) qui met en prise une surface de face définie par le rouleau de rotation (90). 5
 3. Ensemble de rouleau de pliage selon la revendication 1 ou la revendication 2, dans lequel l'agencement de pivot comprend une broche (140, 142) qui s'étend vers l'extérieur depuis l'élément de pliage (125), dans lequel la broche (140, 142) est inclinée par le ressort (155) contre l'agencement de retenue (130, 132). 10
 4. Ensemble de rouleau de pliage selon la revendication 3, dans lequel l'agencement de retenue comprend un capuchon (130, 132) qui comprend une portion de fente (255, 256) pour recevoir la broche (140, 142). 15
 5. Ensemble de rouleau de pliage selon l'une quelconque des revendications précédentes, dans lequel l'élément de pliage (125) comprend une portion de base (190) à l'opposé d'une extrémité pointue (180), et dans lequel la portion de base (190) comprend un retrait (195) pour recevoir le ressort (155). 20
 6. Ensemble de rouleau de pliage selon la revendication 5, dans lequel l'agencement de pivot comprend une broche (140, 142) qui s'étend vers l'extérieur depuis l'élément de pliage (125), et dans lequel au moins une portion de la broche (140, 142) est reçue entre une fente dans la portion de base (190) de l'élément de pliage et une portion de fente (255, 256) dans le capuchon défini par l'agencement de retenue. 25
 7. Ensemble de rouleau de pliage selon l'une quelconque des revendications précédentes, comprenant en outre un rouleau (134, 136) en prise au sein de la fente (160), dans lequel le rouleau (134, 136) guide le mouvement de l'élément de pliage (125) au sein de la fente (160) et dans lequel l'élément de pliage (125) est monté à pivotement au rouleau (134, 136). 30
 8. Ensemble de rouleau de pliage selon la revendication 7, dans lequel l'agencement de pivot comprend une paire de broches s'étendant vers l'extérieur (140, 142) qui s'étendent vers l'extérieur dans des directions opposées depuis l'élément de pliage (125), et dans lequel les broches (140, 142) sont reçues au sein de passages (200a, 200b) définis par l'élément de pliage (125), et dans lequel l'élément de pliage (125) comprend des premier et second re- 35
- traits (215a, 215b) au sein desquels des premier et second rouleaux (134, 136) sont situés, et dans lequel chaque broche (140, 142) est en prise avec un des rouleaux (134, 136) pour fournir un mouvement de pivotement de l'élément de pliage (125) par rapport aux rouleaux (134, 136).
9. Ensemble de rouleau de pliage selon la revendication 1, dans lequel l'agencement de pivot comprend une ou plusieurs broches (140, 142) en prise avec l'élément de pliage (125), et dans lequel chacune des broches (140, 142) comprend une portion externe qui s'étend dans une direction généralement axiale vers l'extérieur depuis l'élément de pliage (125). 40
 10. Ensemble de rouleau de pliage selon la revendication 1, dans lequel l'élément de pliage (126) comprend une portion de base (190) à l'opposé d'une extrémité pointue (180) et une section médiane (185) entre elles, et dans lequel la section médiane (185) comprend un retrait (225a) pour recevoir le ressort (155). 45
 11. Machine de pliage pour le pliage d'une feuille de matériau, comprenant :
 - un premier ensemble de rouleau de pliage selon l'une quelconque des revendications précédentes ; et
 - un second ensemble de rouleau de pliage selon l'une quelconque des revendications précédentes ;
 - le rouleau de rotation (90, 95) de chaque ensemble de rouleau de pliage comprenant une pluralité d'ensembles de pliage (20) distribués autour de sa périphérie espacés en alternance avec une pluralité d'ensembles de pince (100), dans laquelle chaque ensemble de pince (100) de l'un des premier et second ensembles de rouleau de pliage est positionné pour interagir avec un des ensembles de pliage (20) de l'autre des premier et second ensembles de rouleau de pliage pour le pliage d'une feuille de matériau entre eux. 50
 12. Machine de pliage selon la revendication 11, dans laquelle l'agencement de pivot comprend une paire de broches de pivot alignées qui s'étendent vers l'extérieur dans des directions opposées depuis l'élément de pliage. 55
 13. Machine de pliage selon la revendication 12, dans laquelle une première portion d'une première des broches est reçue dans un premier passage défini par l'élément de pliage, et dans laquelle une seconde portion de la première broche est en prise au sein d'un passage d'un élément de pliage adjacent.

14. Procédé d'interaction d'un ensemble de pliage d'un rouleau de pliage avec un ensemble de pince monté sur un rouleau de pliage adjacent avec une feuille de matériau entre eux, le procédé comprenant les actes consistant à :

5

fournir un ensemble de rouleau de pliage selon l'une quelconque des revendications 1 à 10, orienter un ensemble de pliage (20) de l'ensemble de rouleau de pliage adjacent à un ensemble de pince (100) du rouleau de pliage adjacent (95) ;
 faire tourner l'ensemble de rouleau de pliage et le rouleau adjacent de sorte que l'élément de pliage (20) de l'ensemble de rouleau de pliage est en interface avec l'ensemble de pince (100) du rouleau adjacent (95) ;
 forcer l'élément de pliage (125) à venir en prise avec la feuille de matériau contre l'ensemble de pince ; et faire pivoter l'élément de pliage (125) autour d'un agencement de pivot de l'ensemble de pliage (20).

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15. Procédé selon la revendication 14, le procédé comprenant en outre l'étape consistant à :

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rétracter l'élément de pliage dans la fente contre l'inclinaison radialement vers l'extérieur de l'élément de pliage.

30

16. Procédé selon la revendication 14 ou la revendication 15, le procédé comprenant en outre l'étape consistant à :

centrer l'élément de pliage dans la fente autour de l'agencement de pivot.

35

17. Procédé selon l'une quelconque des revendications 14 à 16, comprenant en outre l'étape consistant à :

40

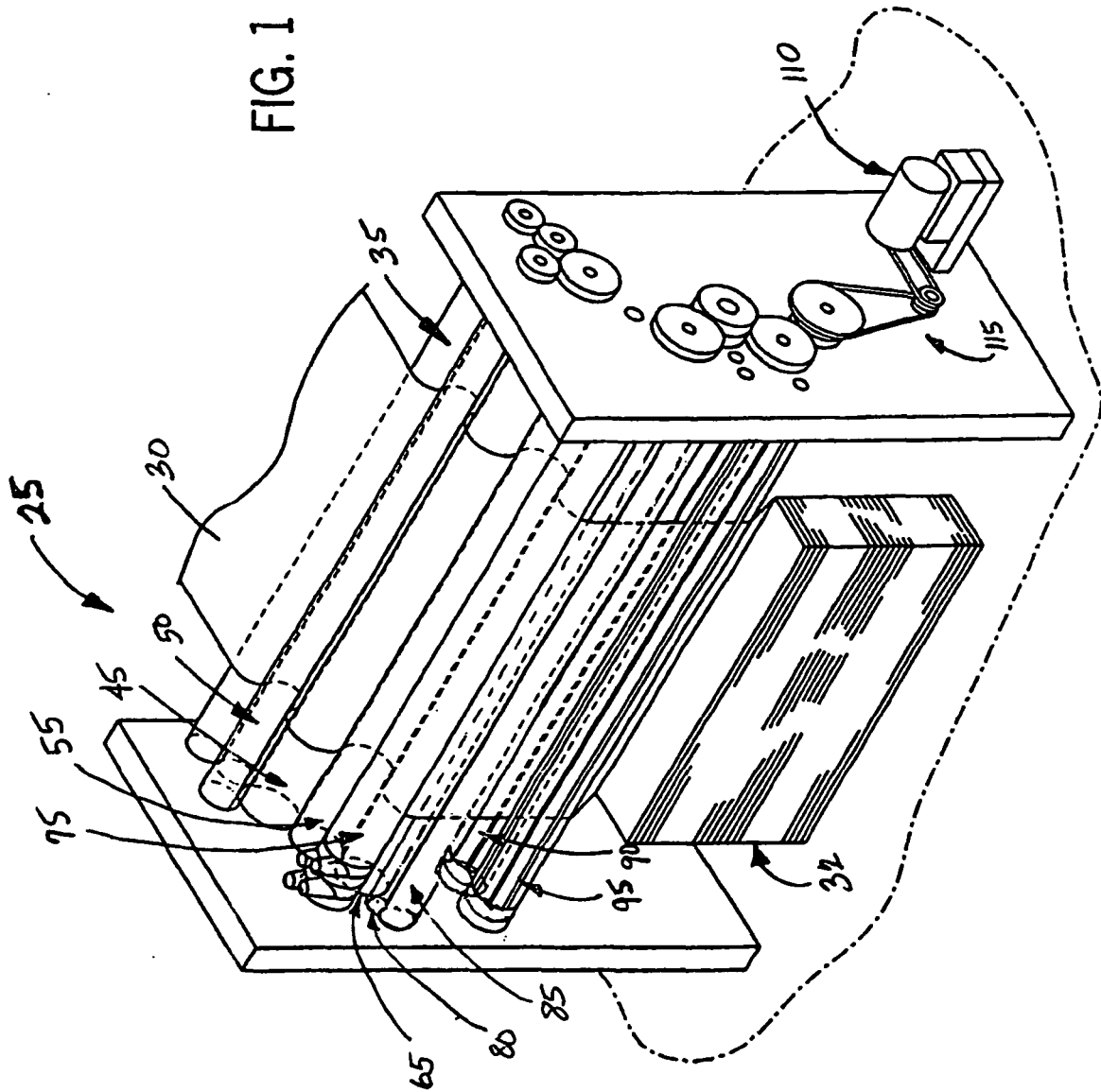
déplacer l'élément de pliage au sein de la fente sur un rouleau contre une surface qui définit la fente dans une direction radialement vers l'intérieur ou la direction radialement vers l'extérieur dans la fente, et dans lequel l'étape de pivotement de l'élément de pliage est effectuée en pivotant l'élément de pliage sur le rouleau.

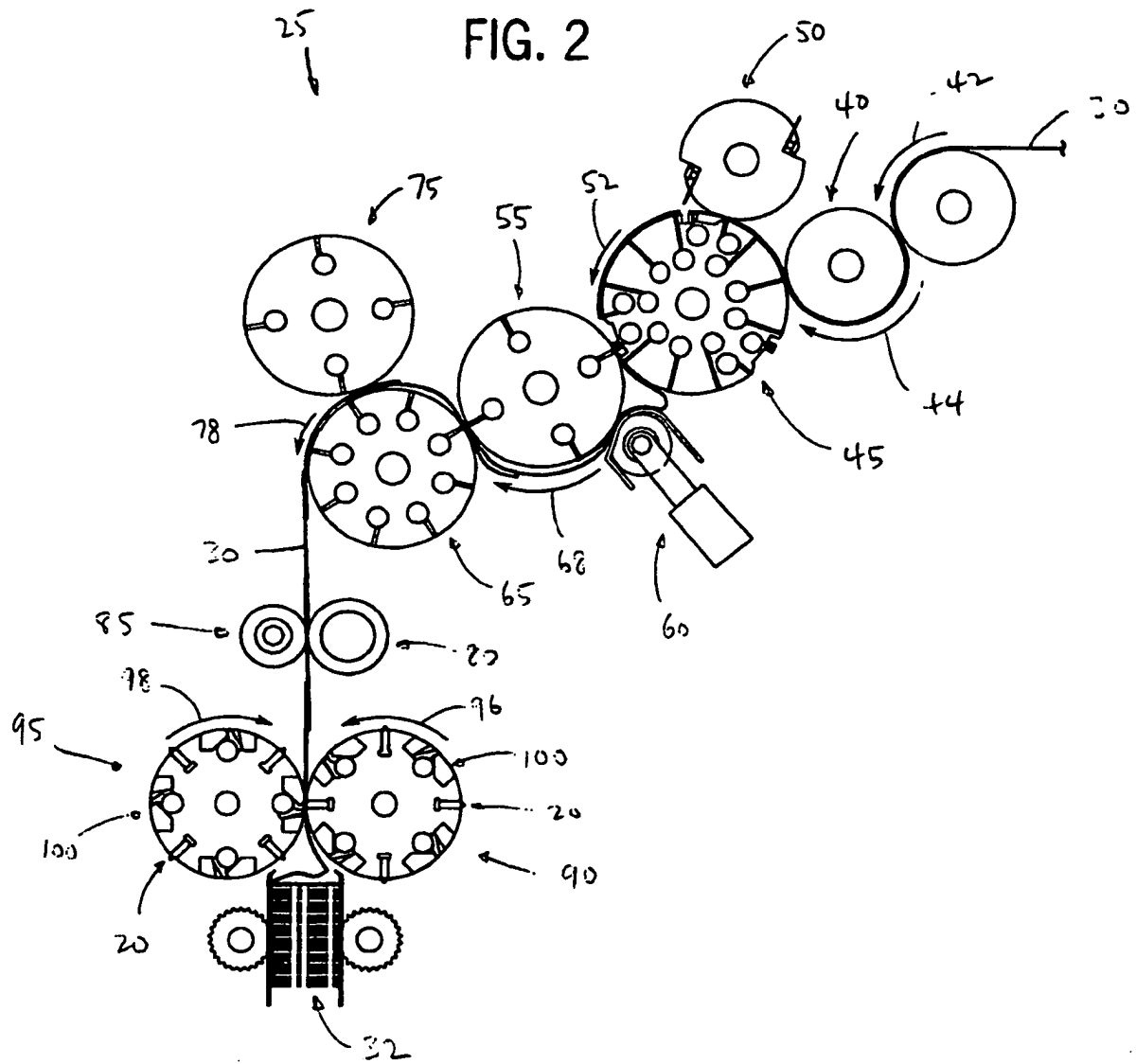
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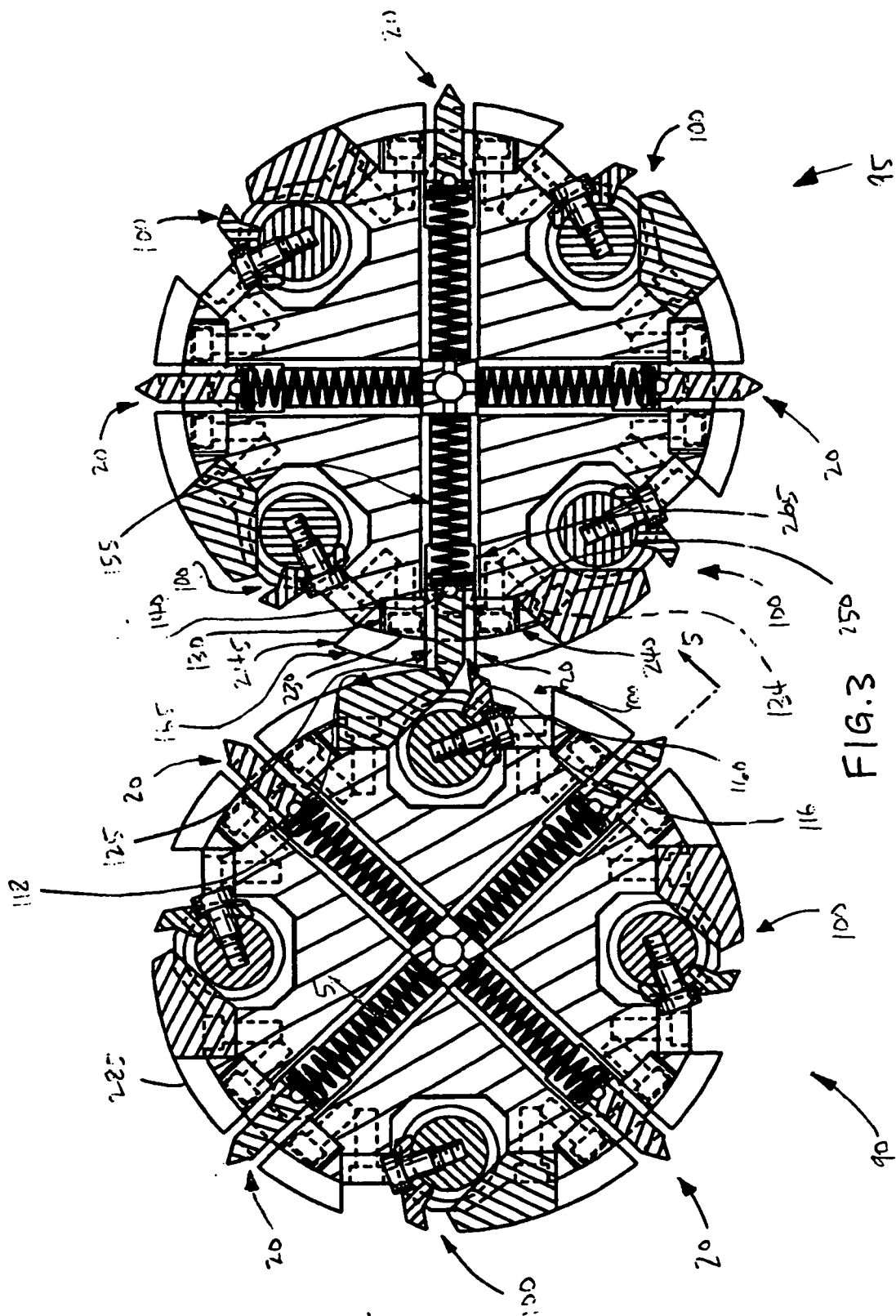
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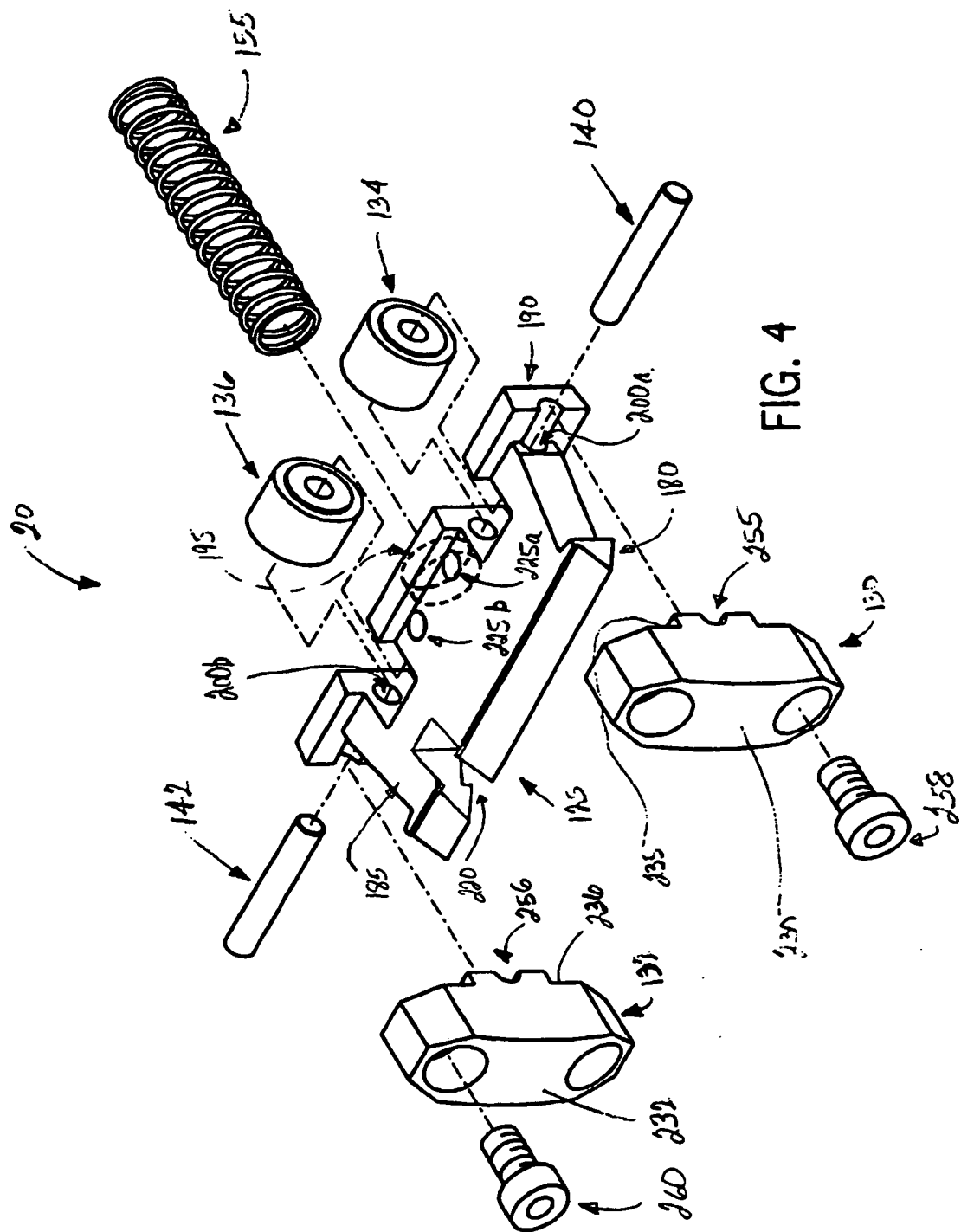
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FIG. 1









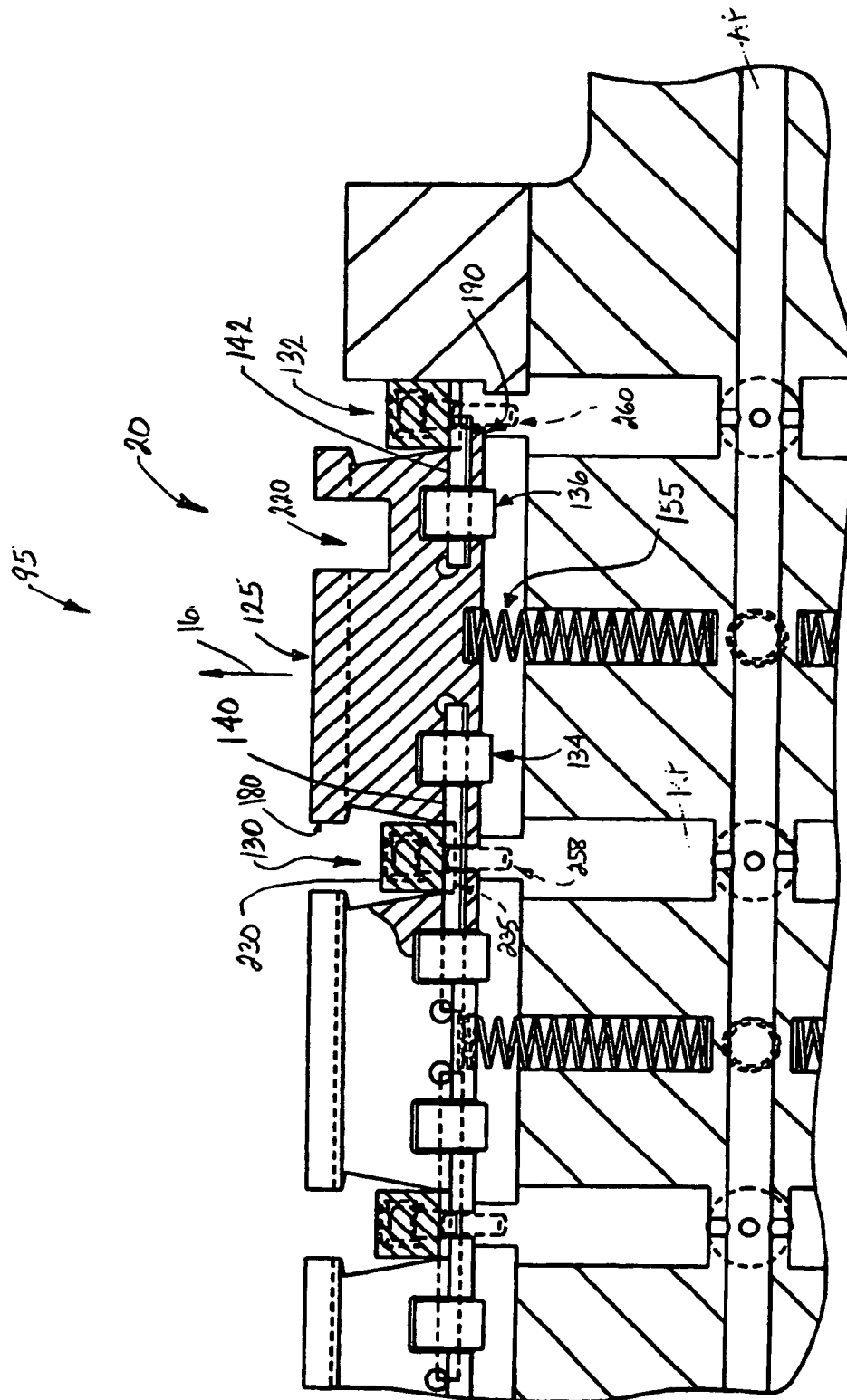


FIG. 5

FIG. 6

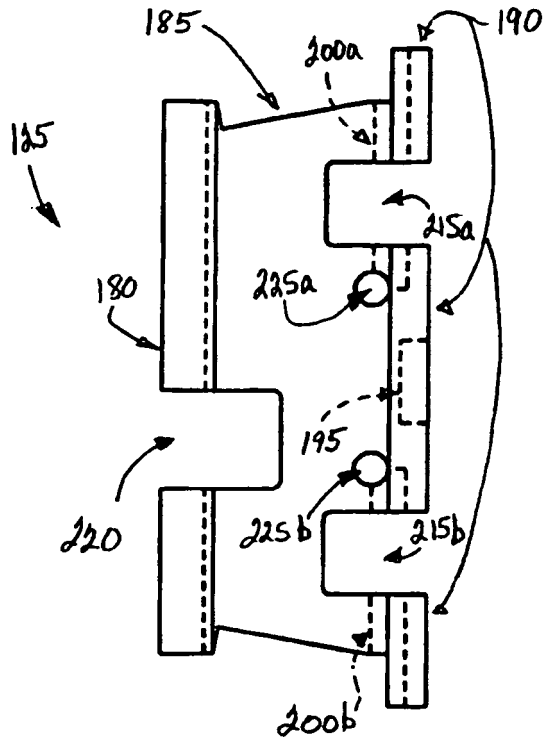


FIG. 7

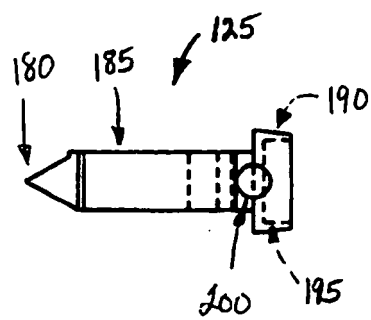
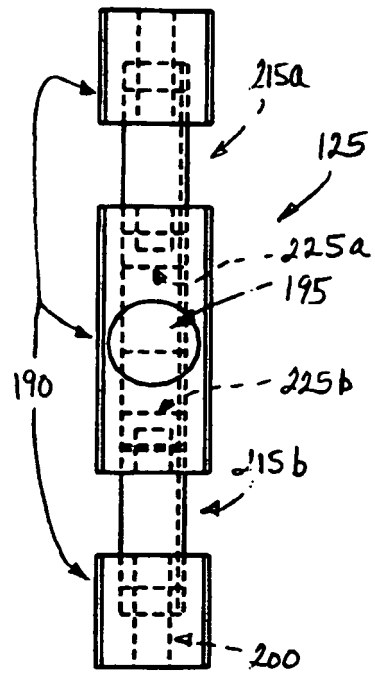
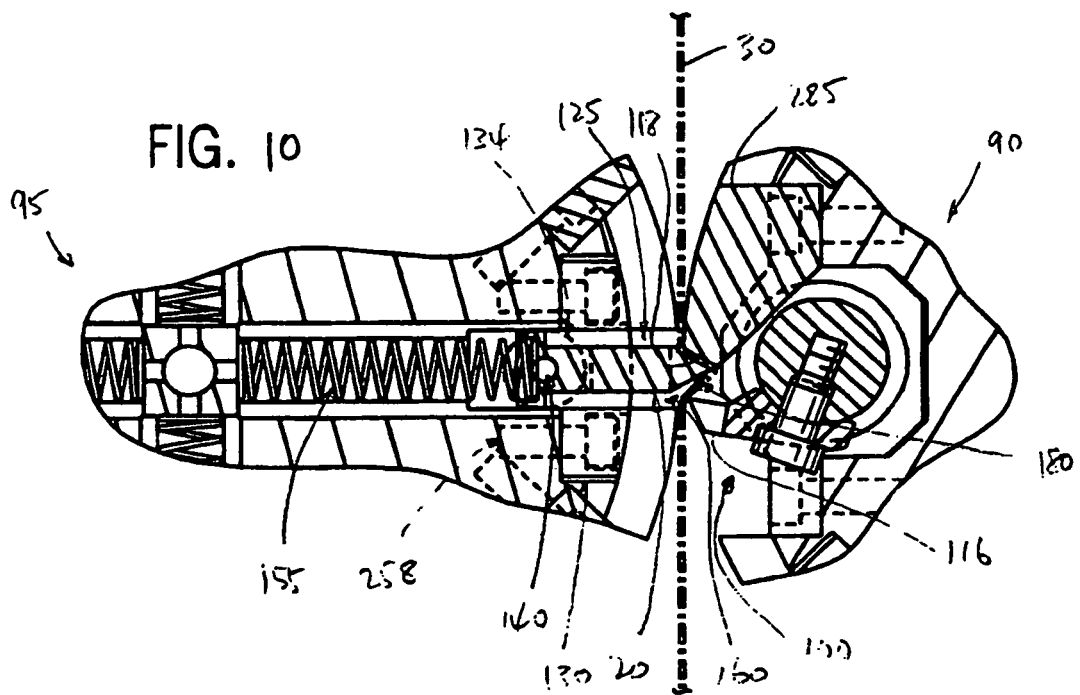
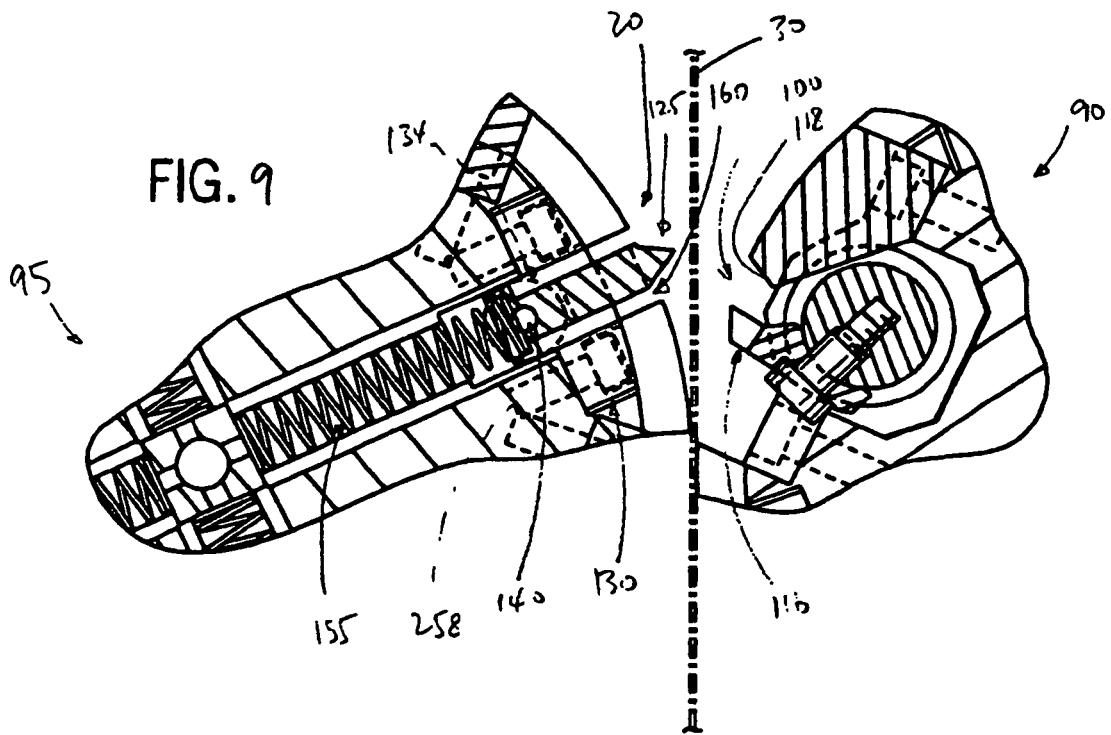
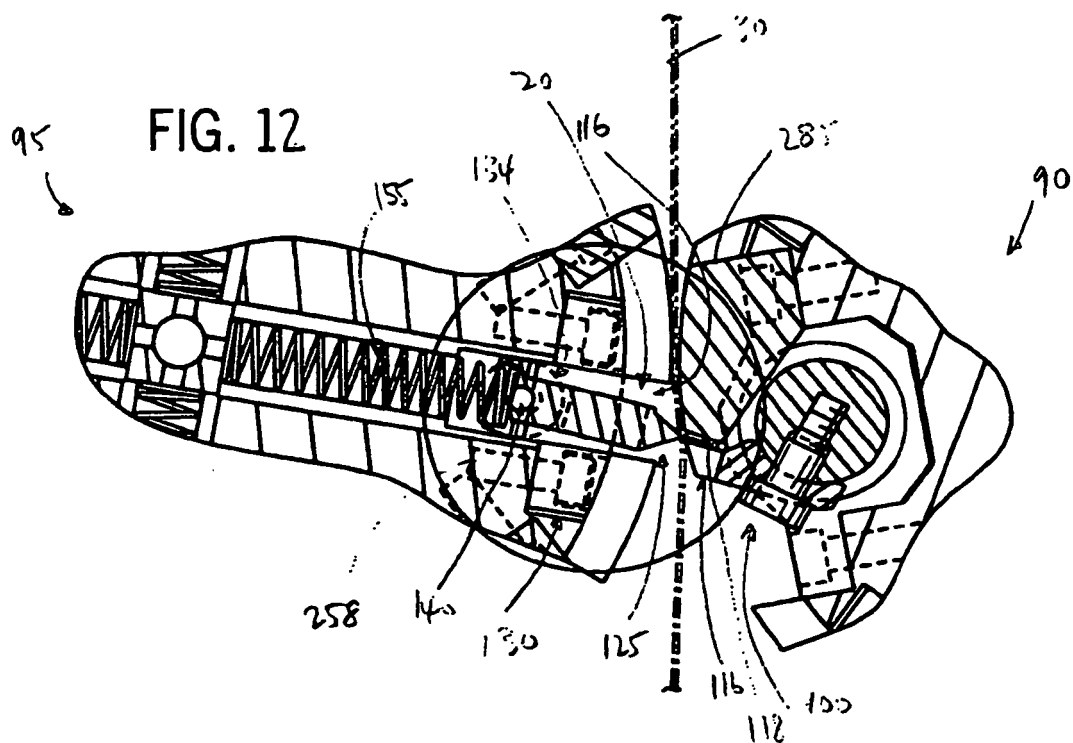
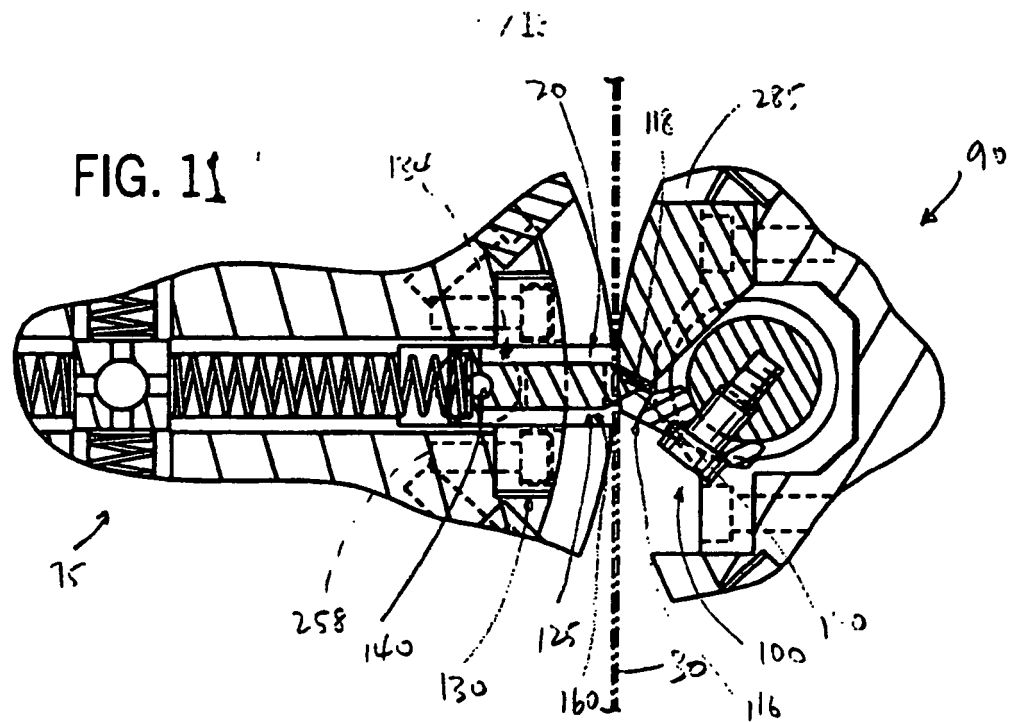


FIG. 8





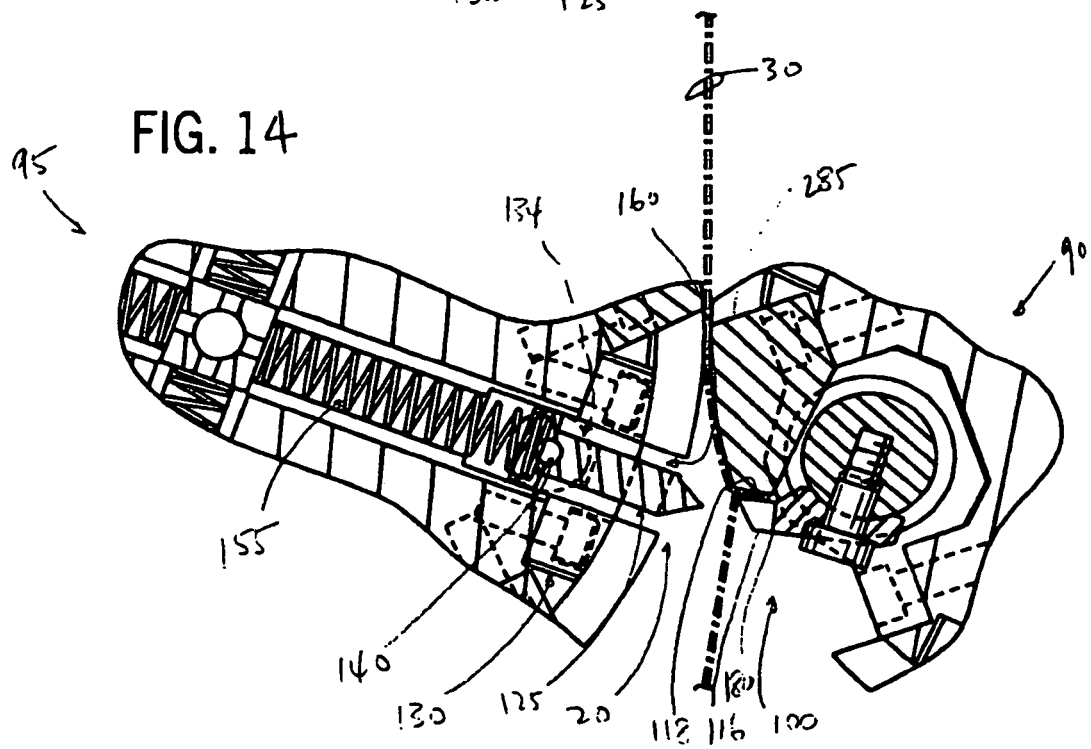
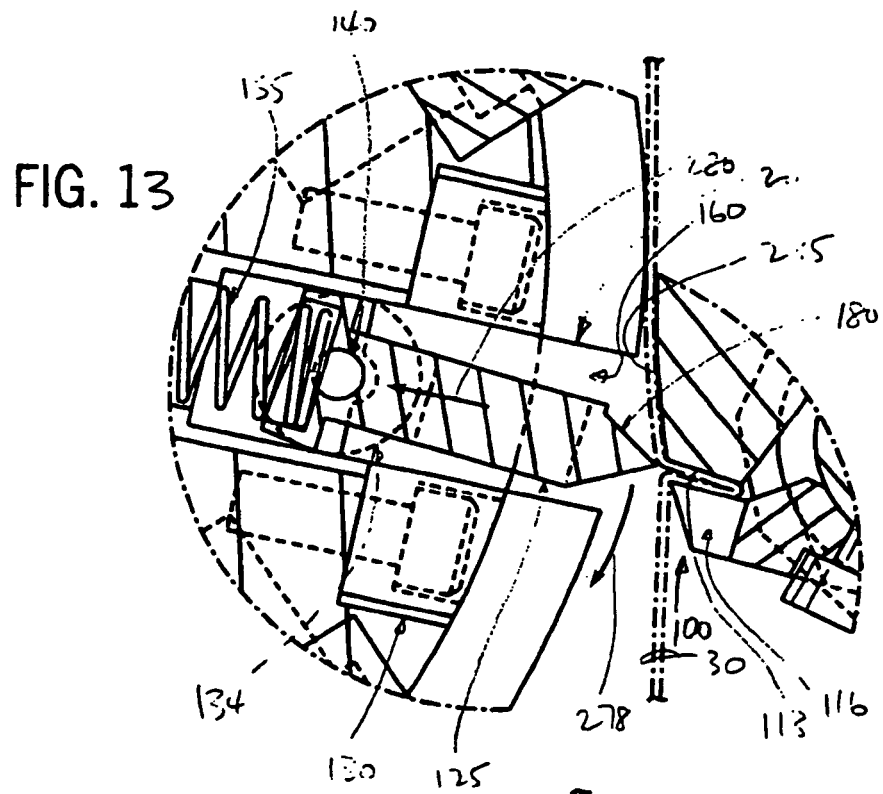
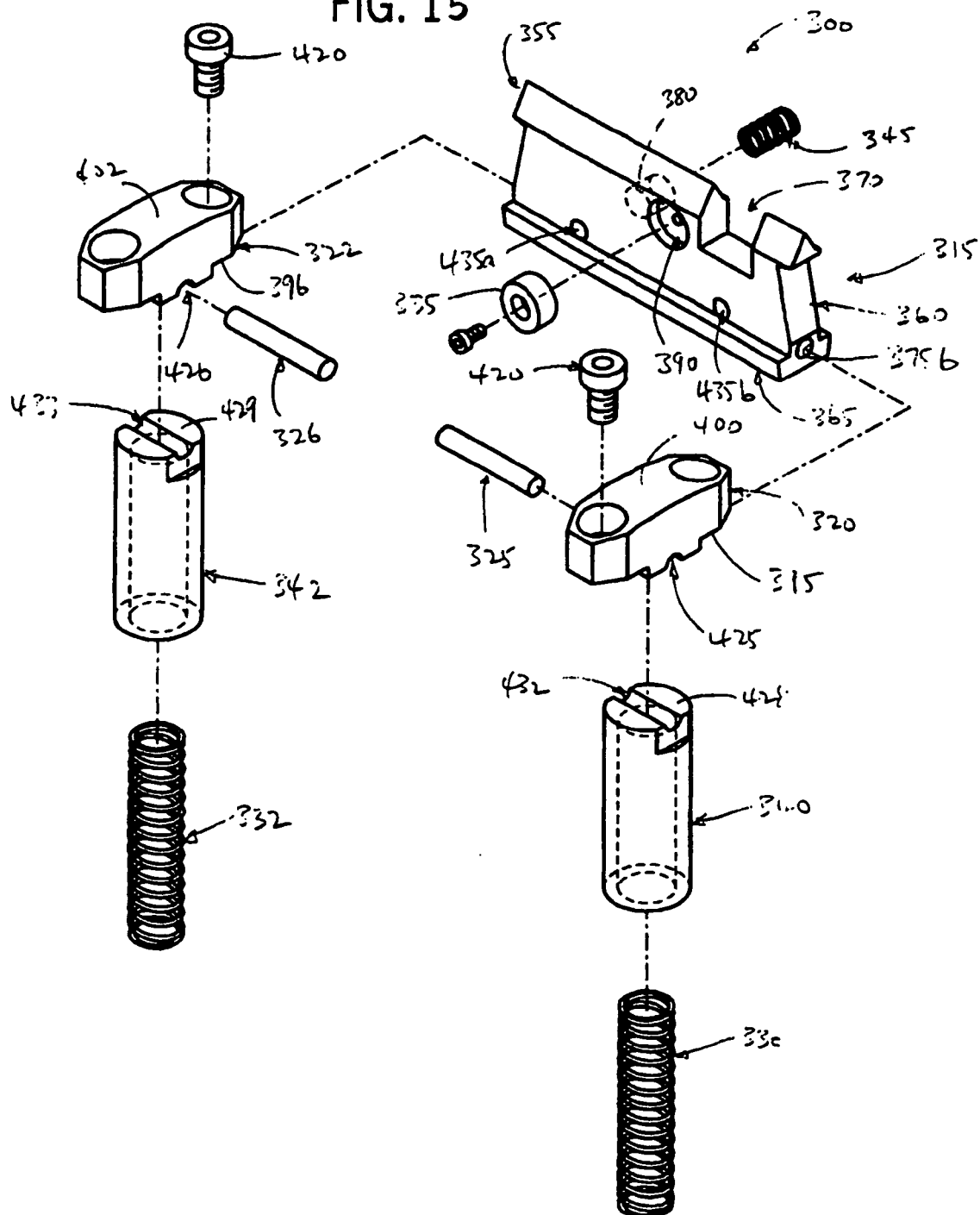


FIG. 15



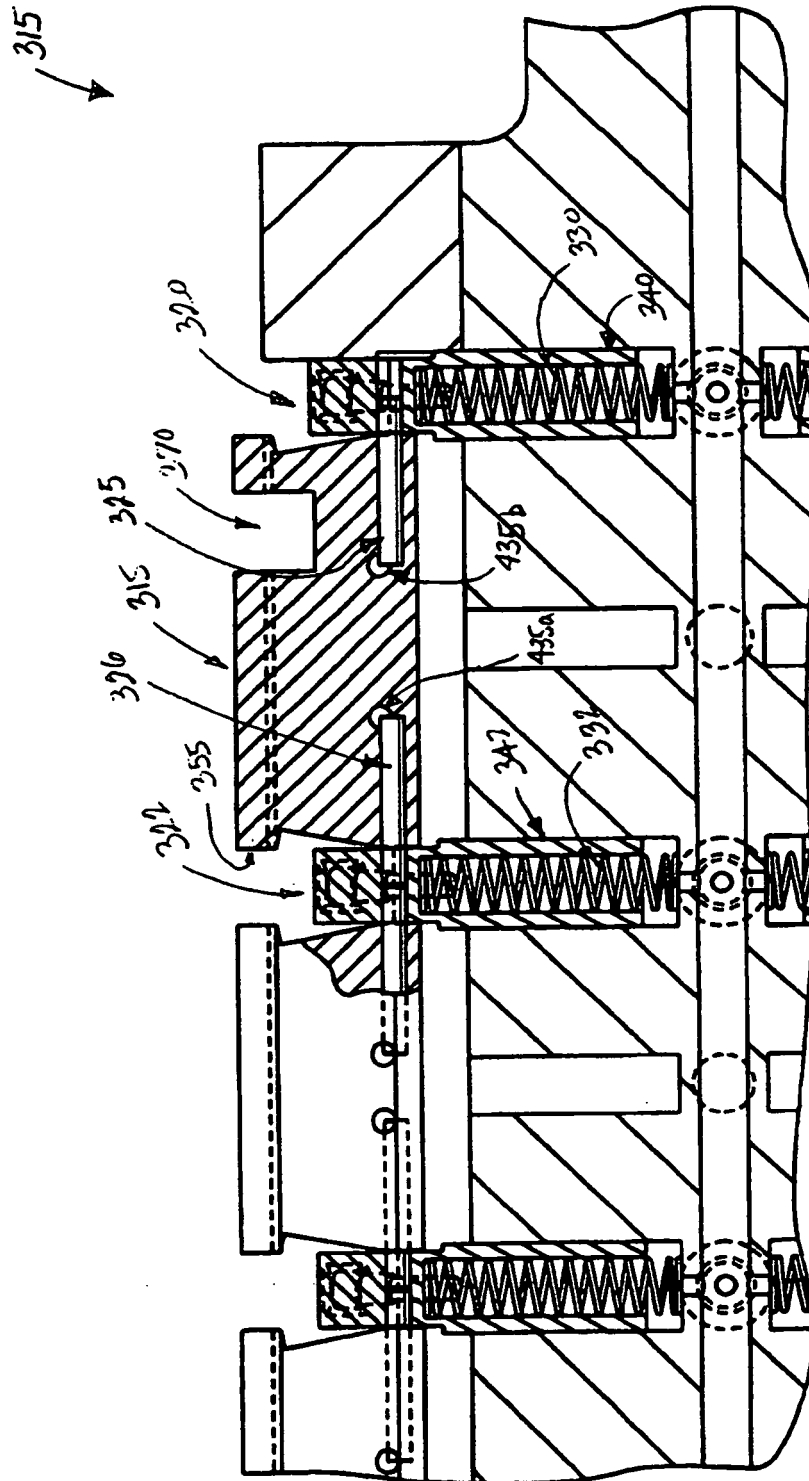


FIG. 16

FIG. 17

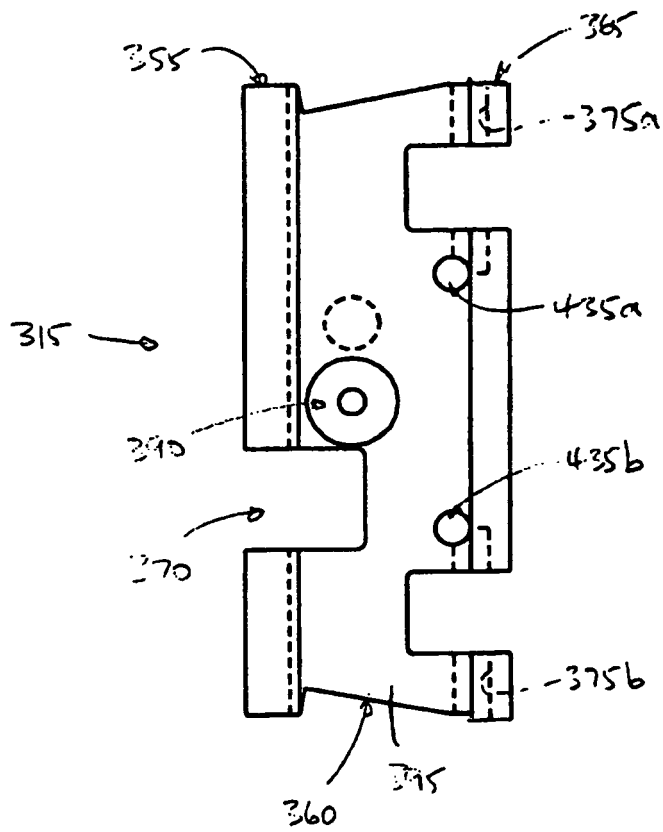


FIG. 18

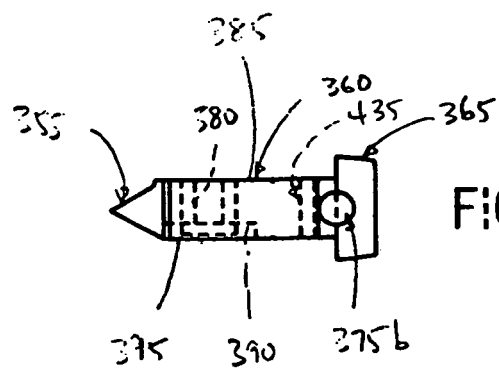
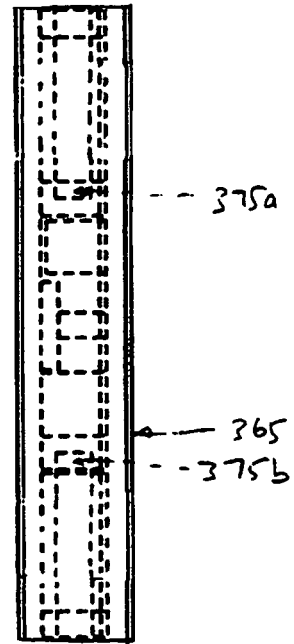
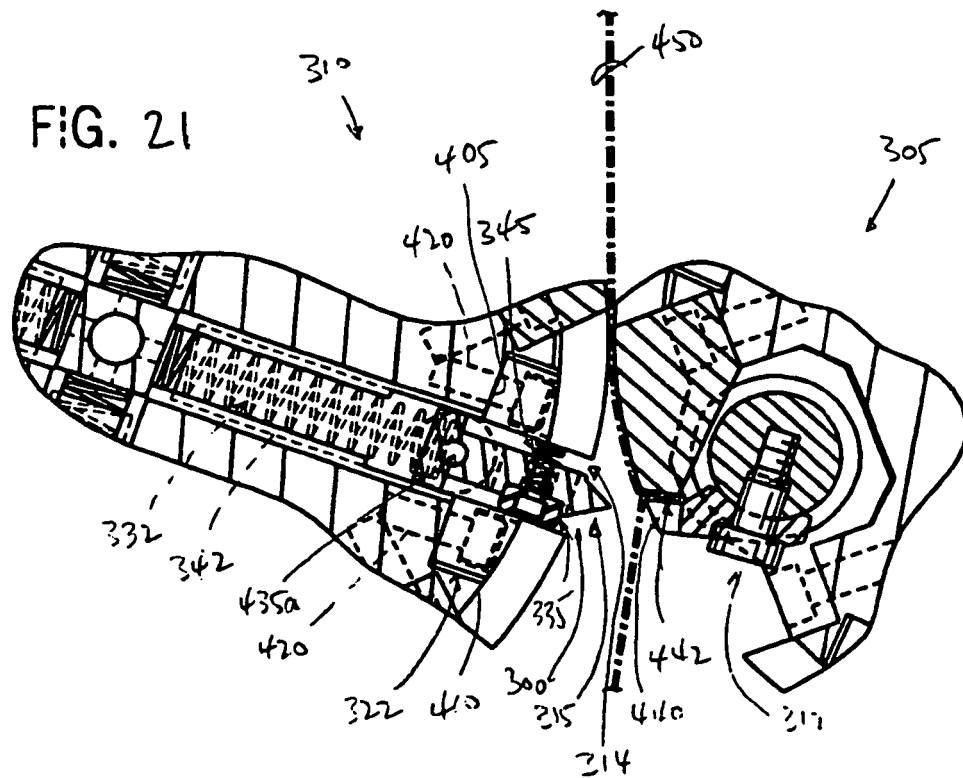
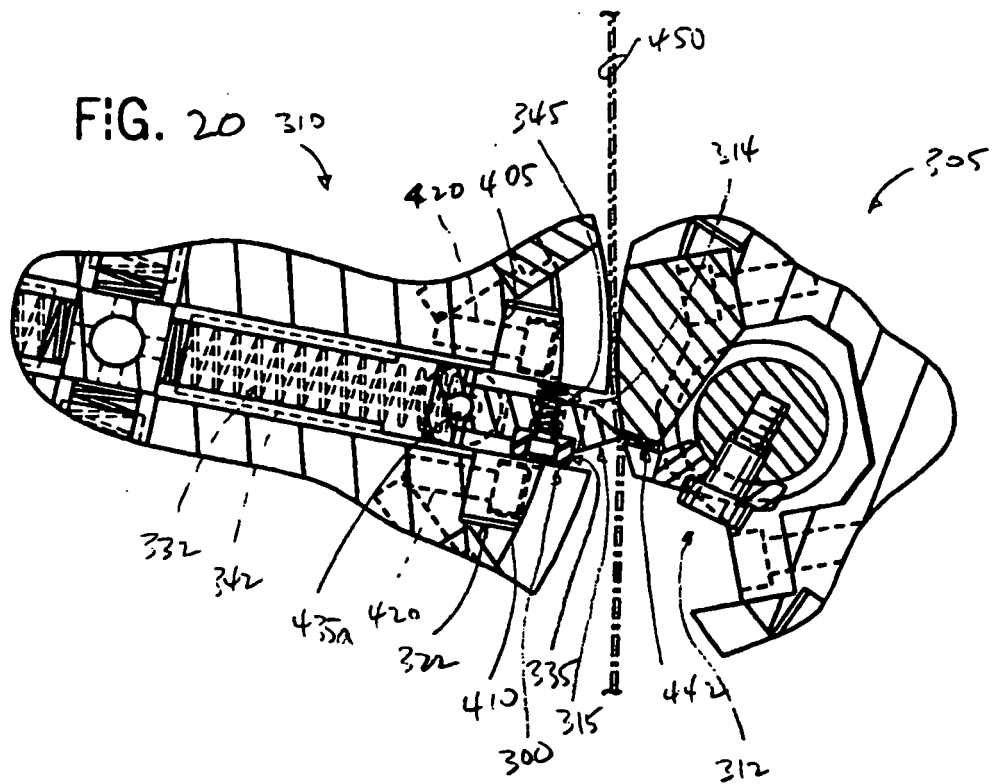


FIG. 19



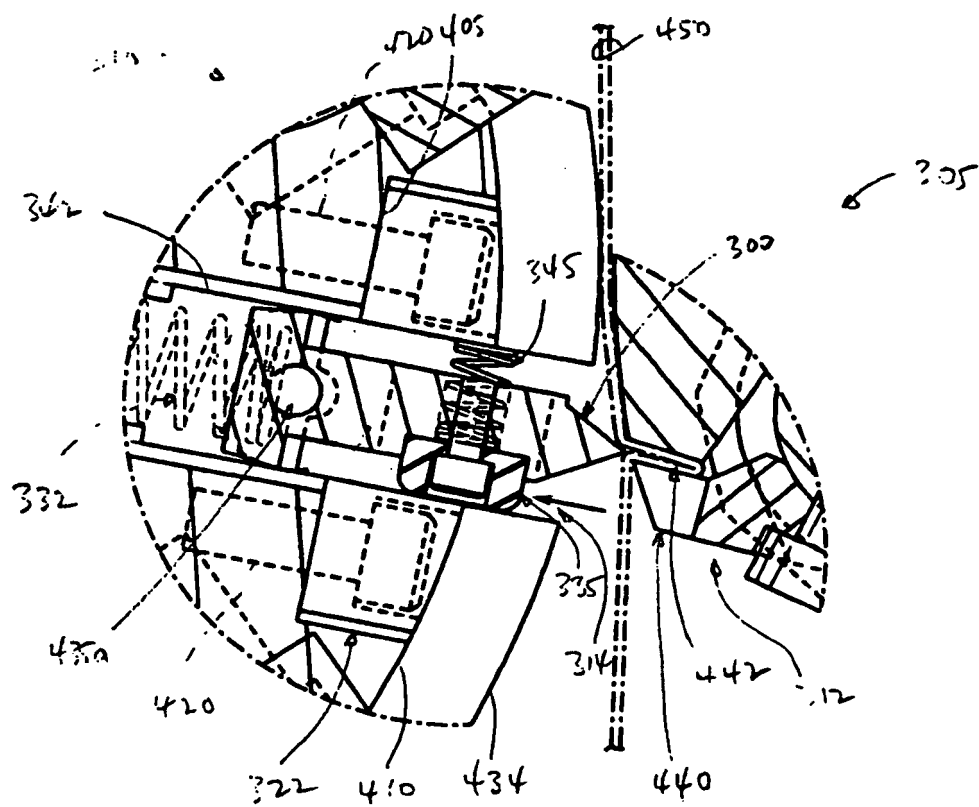


FIG. 22

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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